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(54) PROCESS FOR MAKING SPUN YARN

VERFAHREN ZUR HERSTELLUNG VON GESPONNENEN FÄDEN

PROCEDE POUR LA FABRICATION DE FILES DE FIBRES

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(56) References cited:
EP-A- 0 401 739 **US-A- 4 497 167**

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Description

Background of the Invention

The field of art to which this invention pertains is spun yarn. The invention is more specifically directed to a process for making such yarn from a three-component blend of staple fibers using high speed, air spinning techniques with spinning speeds in excess of 70 meters per minute. In a preferred embodiment these speeds can range from 150 to 220 meters per minute.

The fiber blend used in the process is formed from a plurality of selected filaments. One component of the blend comprises staple fibers made from filaments having an electrically conductive carbon black core and a sheath of non-conductive polymer. The other two components, which are heat-resistant, are preferably formed from filaments of poly(m-phenylene isophthalamide) and of poly(p-phenylene terephthalamide).

The linear densities of the electrically conductive sheath core filaments are no greater than 2.5 times the deniers of the other filaments. This helps prevent or lessens their migration to the surface of the spun yarn during the spinning operation and thereby improves the appearance of the yarn and of the fabrics woven from such yarn.

Summary of the Invention

In the process of this invention, staple fibers formed from electrically conductive first component filaments having a carbon black core are blended with heat-resistant staple fibers, prior to spinning, to impart desired anti-static properties to a fabric or garment made from such fibers.

The invention specifically relates to a process for making spun yarn from a blend of staple fibers formed from a plurality of first, second and third component filaments, wherein the first component is comprised of staple fibers having an electrically conductive carbon black core and a sheath of a non-conductive polymer and the second and third components are comprised of heat-resistant staple fibers, and wherein the conductive filaments have been co-crimped in tow form with non-conductive filaments prior to being processed into staple fibers, comprising forming the blend of staple fibers into a sliver, and spinning the sliver into a spun yarn, characterized by

using spinning techniques wherein a fluid is used to twist the fibers, wherein the linear density per filament of the first component filaments is no greater than about 2.5 times the linear density per filament of the second and third component filaments and wherein the sliver is spun at speeds in excess of 70 meters per minute.

In this process, the blend is first formed into a sliver which is processed into a spun yarn using high speed spinning techniques in which a fluid is used to twist the fibers. The most convenient fluid is air, however, other fluids, such as nitrogen could be used. The appearance of the fabric made from these spun yarns is improved provided the linear density per filament of the electrically conductive filaments is no greater than about 2.5 times the linear density per filament of the filaments used to form the heat-resistant fibers.

The blend consists of at least two other heat resistant components, in addition to the first component, which may be electrically conductive fibers. Preferably these components are fibers formed from filaments of poly(m-phenylene isophthalamide) and poly(p-phenylene terephthalamide).

In a preferred embodiment, the linear density per filament of the first component filaments used to form electrically conductive staple fibers is about 3.33 dtex (3.0 den). The linear density per filament of the second component filaments of the poly(p-phenylene terephthalamide) is about 1.66 dtex (1.5 den); and, the linear density per filament of the third component filaments of poly(m-phenylene isophthalamide) is about 1.88 dtex (1.7 den).

The sliver formed from the three-component blend is spun at high speeds in excess of 70 meters per minute, and, is spun at speeds from 150 to 220 meters per minute. The preferred air spinning technique used to twist the fibers is air-jet spinning.

More specifically, this invention is a process for making a three-component spun yarn comprising the steps of:

forming a first tow from a plurality of heat-resistant filaments;
forming a second tow from a plurality of heat-resistant filaments and a plurality of filaments composed of an electrically conductive carbon black core with a sheath of a non-conductive polymer;
and wherein the linear density of the filaments in the tow having the electrically conductive filaments is no greater than 2.5 times the linear density of the heat-resistant filaments from either tow;
crimping these tows separately, wherein each tow has between 3 and 6 crimps per centimeter (7.6 to 15.2 crimps per inch);
combining the two crimped tows and cutting the tows to form a three-component blend of staple fibers;
carding and forming a sliver of the three-component blend of staple fibers;
spinning the sliver into a spun yarn with spinning techniques which use air or other fluids to twist the fibers.

In another embodiment, this invention is a process for making spun yarn including the steps of:

forming a plurality of first component filaments each having an electrically conductive carbon black core and a sheath of a non-conductive polymer into a first

component yarn;
forming a plurality of second component filaments of non-conductive poly(p-phenylene terephthalamide) into a second component yarn;
forming a plurality of third component filaments of poly(m-phenylene isophthalamide) into a third component yarn;
and wherein the linear density of the filaments of the first component yarn is no greater than about 2.5 times the linear density of the filaments of the second and third yarns;
combining the first and second component yarns into a first tow;
crimping the first tow, wherein such tow has between 3 and 6 crimps per centimeter (7.6 to 15.2 crimps per inch);
forming the third component yarn into a second tow;
crimping the second tow, wherein such tow has between 3 and 6 crimps per centimeter (7.6 to 15.2 crimps per inch);
combining the crimped first and second tows;
cutting the combined tows to form a three-component blend of staple fibers;
forming the blend of staple fibers into a sliver;
spinning the sliver using air spinning techniques to twist the fibers to form a spun yarn suitable for use in making permanently antistatic fabrics.

In this process the first component yarn prior to processing, comprises from about 1 to 5% of the spun yarn by weight;

the second component yarn from about 1 to 25% of the spun yarn by weight; and
the third component yarn comprises at least about 70% of the spun yarn by weight.

Description of the Preferred Embodiments

The three-component blend of staple fibers of this invention is spun at high speeds into spun yarns, which can then be made into fabrics having permanent antistatic properties. Such properties are imparted to the fabric by the sheath-core fibers.

Briefly described, in the process of this invention, a tow of spin-oriented electrically conductive sheath-core filaments and non-conductive poly(p-phenylene terephthalamide) (PPD-T) filaments are crimped together and cutter blended with a separately crimped tow of non-conductive poly(m-phenylene isophthalamide) (MPD-I) filaments using a process as described in U. S. patents 5,001,813 and 5,026,603 both to Rodini. The blend is then cut into staple and processed into a sliver suitable for use in high speed spinning devices to form spun yarn.

The spinning process is preferably accomplished by an air-jet process similar to that generally shown and described in U. S. patent 4,497,167 to Nakahara et al., and a teaching of the production of multiply yarns using this method is generally shown and described in U. S. patent 5,107,671 to Morihashi et al.

The crimping is preferably accomplished in a stuffer box crimper of the type described in U. S. patent 2,747,233 to Hitt.

The PPD-T filaments and MPD-I filaments are heat resistant, that is, they have, either by their inherent nature or by some chemical or other treatment, a limiting oxygen index (L.O.I) of at least 26.5.

The electrically conductive sheath-core filaments which play such a significant role in this invention can be made by the process described in detail, in U. S. patent 4,612,150 to De Howitt.

These conductive filaments have sheaths which can contain additives such as titanium dioxide; the resultant staple fibers are generally light gray in color and are difficult to dye. Such filaments, after further processing, are capable of imparting the desired antistatic properties sought in the garment. This capability would be lost or substantially reduced if these conductive filaments in tow form were crimped alone in a stuffer box crimper prior to being processed into staple fibers. By co-crimping them with the non-conductive filaments, that capability is maintained. As so crimped, the co-crimped tow has a crimp frequency of 3 to 6 uniform crimps per centimeter. This range effectively holds the conductive and non-conductive filaments together in the stuffer box crimper and in the cutter and in subsequent processing without damaging the core of the conductive filaments.

It is important in the practice of the process of this invention that the deniers of the filaments be substantially of the same order. More specifically, the linear density of the first component electrically conductive filaments should be no greater than about 2.5 times the linear densities of the filaments of the second and third component heat-resistant filaments.

In a preferred embodiment, the linear density per filament of the poly(p-phenylene terephthalamide) filaments used in the instant process is about 1.66 dtex (1.5 den); the linear density of the poly(m-phenylene isophthalamide) filaments is about 1.88 dtex (1.7 den); and the linear density of the electrically conductive sheath-core filaments is about 3.33 dtex (3.0 den).

Further, preferably, the electrically conductive first yarn made from these filaments comprises from about 1 to 5% of the spun yarn. The non-conductive second component yarn comprises from about 1 to 25% of such spun yarn, and the non-conductive third component yarn comprises at least about 70% of the spun yarn.

The linear densities of the filaments is significant because filaments of different sizes and weights tend to behave differently when using the high speed air spinning techniques which play such a key role in the practice of this invention. It has been observed, for example, that in those instances where the linear densities of the electrically conductive filaments are over 2.5 times the linear densities of the other filaments that some of these heavier filaments are not spun in and tend to rest on the surface of any fabric made from the spun yarn. This detracts from the overall aesthetics or quality of the fabric and tends to give it a hairy or lint-like appearance or look. Further, these electrically conductive filaments, as processed, are difficult to dye, so even a subsequent dyeing operation would in most cases fail to noticeably improve the appearance of the fabric spun from such yarn.

This appearance problem is most frequently evident when high speed air spinning techniques are used to spin the yarn. If slower, ring spinning techniques are used the linear densities of the filaments is not important since the electrically conductive filaments, even those having a linear density well over 2.5 times the linear density of the other filaments, are effectively spun into the yarn (e.g., at ring spinning speeds from about 20 to 30 meters per minute) and do not tend to rest on the surface.

The high speed air spinning techniques used to spin yarns in accordance with this invention are well known to the art.

Preferably, the spinning technique used is a jet spinning technique, and, more specifically, a Murata-type spinning technique is utilized. An air jet may also be used or a vortex formed to twist the yarn.

"Jet spinning" is a type of air spinning in which a core of generally parallel staple fibers are bound together by surface wrapping fibers which usually constitute a minor portion of the population of fibers.

"Jet spinning" processes are also sometimes referred to as "open end" spinning even though all of the fibers are not detached from the drawn sliver at the gap. For example, in Murata jet spinning a portion of the fiber is detached from the drawn sliver and then reassembled and wrapped around the undetached fibers using at least one vortex formed by air jets to form the spun yarn.

In air jet spinning, speeds from about 150 to 220 meter per minute are obtainable in producing acceptable spun yarns in accordance with this invention. Other air spinning techniques operating at speeds in excess of 70 meters per minute are also usable in obtaining quality yarn having good visual aesthetics.

Comparative Example 1

A blended tow of undrawn, spin-oriented electrically conductive sheath-core filaments and non-conductive poly(p-phenylene terephthalamide) (PPD-T) filaments were crimped together and cutter blended with a separately crimped tow of non-conductive poly(m-phenylene isophthalamide) (MPD-I) filaments using a process as described in U. S. patents 5,001,813 and 5,026,603, both to Rodini. The co-crimping of the PPD-T and the undrawn was accomplished as described in Example 1 of U.S. No. 5,026,603.

The undrawn, spin-oriented electrically conductive sheath-core filaments were supplied as yarn packages of three-filament yarns of sheath-core filaments having a core of polyethylene resin containing about 28 wt. % electrically conductive carbon black and a sheath of polyhexamethylene adipamide, prepared substantially as described in Example 1 (Col. 3, lines 7-68) of U.S. Pat. No. 4,612,150 to De Howitt. The filaments had a linear density of 10.3 decitex (dtex) per filament (9.33 denier per filament = 9.33 dpf).

The PPD-T filaments were supplied as yarn packages of 1000-filament yarns of PPD-T filaments having a linear density of 1.65 dtex per filament (1.5 dpf) and a modulus of about 515 g/dtex (available as Type 29 "Kevlar" aramid fiber from E.I. du Pont de Nemours and Co.).

Seventy-two packages of the 3-filament sheath-core yarn were combined to form a 216-filament yarn, and nineteen packages of the 216-filament sheath-core yarn were mounted on a creel together with seventy-two packages of the 1000-filament PPD-T yarn. The yarns on all of these packages were combined to form a tow of 4104 of the 10.3 dtex sheath-core filaments and 72,000 of the 1.65 dtex PPD-T filaments. This tow was fed into a stuffer-box crimper of the general type shown in U.S. Pat. No. 2,747,233 at a speed of 160 mpm (175 ypm), wherein the tow received a uniform crimp of 4.3 crimps per cm (11 crimps per in).

The crimped tows were cut into staple fibers and blended together to form a staple fiber blend consisting of 93% MPD-I filaments, having a linear density of 1.88 dtex (1.7 den) per filament ; 5% of PPD-T filaments having a linear density of 1.66 dtex (1.5 den) per filament ; and 2% electrically conductive sheath-core filaments having a linear density of 10.33 dtex (9.3 den) per filament.

The staple blend was spun into 394 dtex (30/2 cotton count) staple yarns using a "cotton" system process which included carding the staple blend into sliver(s) using a staple processing card with a stationary top, drawing the fibers, preparation of roving, spinning of the roving into yarn using a ring spinning technique (at a speed of 25 meters per minute), followed by twisting and plying of the spun yarns.

These yarns were woven into a Plain Weave, 152.6 g/m^2 (4.5 Oz./Sq.Yd.) fabric.

The fabric was then dyed with cationic dyes. The resulting fabrics are characterized as having good visual aesthetics, i.e., the fabric does not have a "linty" or "hairy" appearance.

Comparative Example 2

A staple blend was prepared as in Example 1 and spun into 394 dtex (30/2 cotton count) yarns using a No. 881 MTS (Murata Twin Spinner) air jet spinner wherein air is used to twist the fibers and the spun yarns are plied two-for-one. This equipment has the capability to spin yarns directly from a sliver and spin at considerably higher spinning speeds than those used in Example 1 (e.g., from 150 to 220 meters per minute). The speed used to prepare the sample was 190 meters per minute. The fibers, prior to spinning, were also subjected to increased carding speeds using a staple processing card with revolving flats and thus were subjected to greater mechanical action as compared to the carding processing used in Example 1.

These yarns were woven into a Plain Weave, 152.6 g/m^2 (4.5 Oz./Sq.Yd.) fabric. The fabric is then dyed with cationic dyes. The resulting fabrics are characterized as having poor visual aesthetics as characterized as a "hairy" or "linty" appearance. Analysis of the fabrics indicates that the "hairy" or "linty" look is due to the electrically conductive sheath-core filaments protruding from or resting on the surface of the fabric.

Example 3

A staple blend was prepared as in Example 1, except that the electrically conductive sheath-core filaments were drawn from a linear density of 10.33 dtex (9.3 den) per filament to approximately a linear density of 3.33 dtex (3.0 den) per filament.

This blend was spun into 394 dtex (30/2 cotton count) yarns using the Murata yarn processing equipment and speeds as described in Example 2 and employing the same high speed air jet spinning technique. These yarns were woven into a Plain Weave 152.6 g/m^2 (4.5 Oz./Sq.Yd) fabric.

The fabric is then dyed with cationic dyes. The resulting fabrics are characterized as having good visual aesthetics, that is, the surface of the fabric had little "hairy" or "linty" appearance.

Claims

1. A process for making spun yarn from a blend of staple fibers formed from a plurality of first, second and third component filaments, wherein the first component is comprised of staple fibers having an electrically conductive carbon black core and a sheath of a non-conductive polymer and the second and third components are comprised of heat-resistant staple fibers, and wherein the conductive filaments have been co-crimped in tow form with non-conductive filaments prior to being processed into staple fibers, comprising forming the blend of staple fibers into a sliver, and spinning the sliver into a spun yarn, characterized by

   using spinning techniques wherein a fluid is used to twist the fibers, wherein the linear density per filament of the first component filaments is no greater than about 2.5 times the linear density per filament of the second and third component filaments and wherein the sliver is spun at speeds in excess of 70 meters per minute.

2. The process of Claim 1 wherein the linear density per filament of the first component filament is about 3.33 dtex (3.0 den); the linear density per filament of the second component filament is about 1.66 dtex (1.5 den); and, the linear density per filament of the third component filament is about 1.88 dtex (1.7 den).

3. The process of Claim 1 wherein the spinning technique used to twist the fibers is air-jet spinning.

4. The process of Claim 1 wherein the sliver is spun at speeds from 150 to 220 meters per minute.

5. The process of Claim 1 wherein the heat-resistant staple fibers are poly(m-phenylene isophthalamide) and poly(p-phenylene terephthalamide).

6. The process of Claim 1 comprising the steps of:

   forming a first tow from a plurality of heat-resistant filaments;
   forming a second tow from a plurality of heat-resistant filaments and a plurality of filaments composed of an electrically conductive carbon black core with a sheath of a non-conductive polymer;
   and wherein the linear density of the filaments having the electrically conductive carbon black core is no greater than 2.5 times the linear density of the heat-resistant filaments from either tow;
   crimping these tows separately, wherein each tow has between 3 and 6 crimps per centimeter (7.6 to 15.2 crimps per inch);
   combining tows and cutting the tows to form a three-component blend of staple fibers;
   carding and forming a sliver of the three-component blend of staple fibers;
   spinning the sliver into spun yarns with spinning techniques which use a fluid to twist the fibers and wherein the sliver is spun at speeds in excess of 70 meters per minute.

7. The process of Claim 1 including the steps of:

   forming a plurality of first component filaments each having an electrically conductive carbon black core and a sheath of a non-conductive polymer into a first component yarn;
   forming a plurality of second component filaments of non-conductive poly(p-phenylene terephthalamide) into a second component yarn;
   forming a plurality of third component filaments of poly(m-phenylene isophthalamide) into a third component yarn;
   and wherein the linear density of the filaments of the first component yarn is no greater than

about 2.5 times the linear densities of the filaments of the second and third yarns;
combining the first and second component yarns into a first tow;
crimping the first tow, wherein such tow has between 3 and 6 crimps per centimeter (7.6 to 15.2 crimps per inch);
forming the third component yarn into a second tow;
crimping the second tow, wherein such tow has between 3 and 6 crimps per centimeter (7.6 to 15.2 crimps per inch);
combining the crimped first and second tows;
cutting the combined tows to form a three-component blend of staple fibers;
forming the blend of staple fibers into a sliver;
spinning the sliver using air spinning techniques to twist the fibers to form a spun yarn suitable for use in making permanently antistatic fabrics and wherein the sliver is spun at speeds in excess of 70 meters per minute.

8. The process of Claim 7 wherein the sliver is spun at speeds from 150 to 220 meters per minute.

9. The process of Claim 7 wherein the first component yarn comprises from about 1 to 5% of the spun yarn by weight.

10. The process of Claim 7 wherein the second component yarn comprises from about 1 to 25% of the spun yarn by weight.

11. The process of Claim 7 wherein the third component yarn comprises at least about 70% of the spun yarn by weight.

12. The process of Claim 1 wherein the fluid used to twist the fibers is air.

13. The process of Claim 6 wherein the fluid used to twist the fibers is air.

Patentansprüche

1. Verfahren zur Herstellung von Spinnfasergarn aus einer Mischung von Stapelfasern, die von einer Mehrzahl von ersten, zweiten und dritten Filamentkomponenten gebildet werden, wobei die erste Komponente aus Stapelfasern mit einem elektrisch leitfähigen Rußkern und einer Hülle aus einem nicht-leitfähigen Polymeren besteht und die zweite und dritte Komponente aus wärmebeständigen Stapelfasern besteht, und wobei die leitfähigen Filamente in Kabelform mit nicht-leitfähigen Filamenten co-gekräuselt worden sind, bevor sie zu Stapelfasern verarbeitet wurden, umfassend das Formen der Mischung aus Stapelfasern zu einem Faserband und Spinnen des Faserbandes zu einem Spinnfasergarn,
dadurch gekennzeichnet, daß
Spinntechniken angewandt werden, bei denen ein Fluid zum Zwirnen der Fasern verwendet wird, wobei die lineare Dichte pro Filament der ersten Filamentkomponente nicht mehr als das etwa 2,5-fache der linearen Dichte pro Filament der zweiten und dritten Filamentkomponente beträgt, und wobei das Faserband bei Geschwindigkeiten von mehr als 70 m pro Minute gesponnen wird.

2. Verfahren nach Anspruch 1, bei welchem die lineare Dichte pro Filament der ersten Filamentkomponente etwa 3,33 dtex (3,0 den); die lineare Dichte pro Filament der zweiten Filamentkomponente etwa 1,66 dtex (1,5 den) und die lineare Dichte pro Filament der dritten Filamentkomponente etwa 1,88 dtex (1,7 den) beträgt.

3. Verfahren nach Anspruch 1, bei welchem die zum Zwirnen der Fasern angewandte Spinntechnik das Luftdüsenspinnen ist.

4. Verfahren nach Anspruch 1, bei welchem das Faserband bei Geschwindigkeiten von 150 bis 220 m pro Minute versponnen wird.

5. Verfahren nach Anspruch 1, bei welchem die wärmebeständigen Stapelfasern aus Poly(m-phenylenisophthalamid) und Poly(p-phenylenterephthalamid) bestehen.

6. Verfahren nach Anspruch 1, umfassen die Schritte:

das Bilden eines ersten Kabels aus einer Mehrzahl von wärmebeständigen Filamenten;
das Bilden eines zweiten Kabels aus einer Mehrzahl von wärmebeständigen Filamenten und einer Mehrzahl von Filamenten, die aus einem elektrisch leitfähigen Rußkern mit einer Hülle aus einem nicht-leitfähigen Polymeren aufgebaut sind;
und wobei die lineare Dichte der Filamente mit dem elektrisch leitfähigen Rußkern nicht mehr als das 2,5-fache der linearen Dichte der wärmebeständigen Filamente von jedem der Kabel beträgt;
das getrennte Kräuseln dieser Kabel, wobei jedes Kabel zwischen 3 und 6 Kräuselungen pro Zentimeter (7,6 bis 15,2 Kräuselungen pro inch) aufweist;
das Vereinigen der Kabel und das Schneiden der Kabel unter Bildung einer Dreikomponentenmischung von Stapelfasern;
das Kardieren und Bilden eines Faserbandes aus der Dreikomponentenmischung von Sta-

pelfasern;
das Verspinnen des Faserbandes zu Spinnfasergarnen unter Anwendung von Spinntechniken, bei denen ein Fluid zum Zwirnen der Fasern eingesetzt wird, und bei welchen das Faserband bei Geschwindigkeiten von mehr als 70 m pro Minute versponnen wird.

7. Verfahren nach Anspruch 1, umfassend die Schritte:

   das Bilden einer Mehrzahl von ersten Filamentkomponenten, welche jeweils einen elektrisch leitfähigen Rußkern und eine Hülle aus einem nicht-leitfähigen Polymeren aufweisen, zu einer ersten Garnkomponente;
   das Bilden einer Mehrzahl von zweiten Filamentkomponenten aus nicht-leitfähigem Poly (p-phenylenterephthalamid) zu einer zweiten Garnkomponente;
   das Bilden einer Mehrzahl von dritten Filamentkomponenten aus Poly(m-phenylenisophthalamid) zu einer dritten Garnkomponente;
   und wobei die lineare Dichte der Filamente der ersten Garnkomponente nicht mehr als das etwa 2,5-fache der linearen Dichten der Filamente der zweiten und dritten Garne beträgt;
   das Vereinigen der ersten und zweiten Garnkomponenten zu einem ersten Kabel;
   das Kräuseln des ersten Kabels, wobei ein solches Kabel zwischen 3 und 6 Kräuselungen pro Zentimeter (7,6 bis 15,2 Kräuselungen pro inch) aufweist;
   das Formen der dritten Garnkomponente zu einem zweiten Kabel;
   das Kräuseln des zweiten Kabels, wobei ein solches Kabel zwischen 3 und 6 Kräuselungen pro Zentimeter (7,6 bis 15,2 Kräuselungen pro inch) aufweist;
   das Vereinigen des ersten und des zweiten Kabels;
   das Schneiden der vereinigten Kabel unter Bildung einer Dreikomponentenmischung von Stapelfasern;
   das Formen der Mischung von Stapelfasern zu einem Faserband;
   das Verspinnen des Faserbandes unter Anwendung von Luftspinntechniken zum Zwirnen der Fasern unter Bildung eines Spinnfasergarns, das zur Herstellung von permanent antistatischen Stoffen geeignet ist, und wobei das Faserband bei Geschwindigkeiten von mehr als 70 m pro Minute versponnen wird.

8. Verfahren nach Anspruch 7, bei welchem das Faserband bei Geschwindigkeiten von 150 bis 220 m pro Minute versponnen wird.

9. Verfahren nach Anspruch 7, bei welchem die erste Garnkomponente etwa 1 bis 5 Gew.-% des Spinnfasergarns umfaßt.

10. Verfahren nach Anspruch 7, bei welchem die zweite Garnkomponente etwa 1 bis 25 Gew.-% des Spinnfasergarns umfaßt.

11. Verfahren nach Anspruch 7, bei welchem die dritte Garnkomponente wenigstens etwa 70 Gew.-% des Spinnfasergarns umfaßt.

12. Verfahren nach Anspruch 1, bei welchem das zum Zwirnen der Fasern verwendete Fluid Luft ist.

13. Verfahren nach Anspruch 6, bei welchem das zum Zwirnen der Fasern verwendete Fluid Luft ist.

Revendications

1. Procédé de production d'un filé à partir d'un mélange de fibres discontinues formées à partir de plusieurs filaments de premier, deuxième et troisième composants, le premier composant étant composé de fibres discontinues comportant une âme en noir de carbone électroconducteur et une gaine en polymère non conducteur, les deuxième et troisième composants étant composés de fibres discontinues résistantes à la chaleur, les filaments conducteurs ayant été frisés en une forme de câble ensemble avec les filaments non conducteurs avant leur transformation en fibres discontinues, comprenant l'étape de formation d'un ruban à partir du mélange de fibres discontinues et de filage du ruban en un filé,

   caractérisé par

   l'application de techniques de filage dans lesquelles un fluide est utilisé pour tordre les fibres, la densité linéaire par filament des filaments du premier composant ne dépassant pas de plus d'environ 2,5 fois la densité linéaire par filament des filaments des deuxième et troisième composants, et le ruban étant filé à des vitesses supérieures à 70 mètres par minute.

2. Procédé selon la revendication 1, dans lequel la densité linéaire par filament des filaments du premier composant est d'environ 3,33 dtex (3,0 deniers), la densité linéaire par filament des filaments du deuxième composant étant d'environ 1,66 dtex (1,5 denier), et la densité linéaire par filament des filaments du troisième composant étant de 1,88 dtex(1,7 denier).

3. Procédé selon la revendication 1, dans lequel la technique de filage appliquée pour tordre les fibres est un filage par jet d'air.

4. Procédé selon la revendication 1, dans lequel le ruban est filé à des vitesses allant de 150 à 220 mètres par minute.

5. Procédé selon la revendication 1, dans lequel les fibres discontinues résistantes à la chaleur sont composées de poly(m-phénylène isophtalamide) et de poly(p-phénylène térephtalamide).

6. Procédé selon la revendication 1, comprenant les étapes ci-dessous:

   formation d'un premier câble à partir de plusieurs filaments résistants à la chaleur;
   formation d'un deuxième câble à partir de plusieurs filaments résistants à la chaleur et de plusieurs filaments composés d'une âme en noir de carbone électroconducteur et d'une gaine en polymère non conducteur;
   la densité linéaire des filaments comportant l'âme en noir de carbone électroconducteur ne dépassant pas de plus de 2,5 fois la densité linéaire des filaments résistants à la chaleur des deux câbles;
   frisage séparé de ces câbles, chaque câble comportant entre 3 et 6 frisures par centimètre (7,6 à 15,2 frisures par pouce);
   combinaison des câbles et découpage des câbles pour former un mélange à trois composants de fibres discontinues;
   cardage et formation d'un ruban à partir du mélange à trois composants de fibres discontinues;
   filage du ruban en filés par l'intermédiaire de techniques de filage utilisant un fluide pour tordre les fibres, le ruban étant filé à des vitesses supérieures à 70 mètres par minute.

7. Procédé selon la revendication 1, englobant les étapes ci-dessous:

   formation d'un fil de premier composant à partir de plusieurs filaments du premier composant, comportant chacun une âme en noir de carbone électroconducteur et une gaine en polymère non conducteur;
   formation d'un fil de deuxième composant à partir de plusieurs filaments du deuxième composant en poly(p-phénylène térephtalamide) non conducteur;
   formation d'un fil de troisième composant à partir de plusieurs filaments du troisième composant en poly(m-phénylène isophtalamide);
   la densité linéaire des filaments du fil du premier composant ne dépassant pas de plus d'environ 2,5 fois les densités linéaires des filaments des deuxième et troisième fils;
   combinaison des fils du premier et deuxième composants en un premier câble;
   frisage du premier câble, un tel câble comportant entre 3 et 6 frisures par centimètre (7,6 à 15,2 frisures par pouce);
   formation du fil du troisième composant en un deuxième câble;
   frisage du deuxième câble, un tel câble comportant entre 3 et 6 frisures par centimètre (7,6 à 15,2 frisures par pouce);
   combinaison des premier et deuxième câbles frisés;
   découpage des câbles combinés pour former un mélange à trois composants de fibres discontinues;
   formation d'un ruban à partir du mélange de fibres discontinues;
   filage du ruban avec application de techniques de filage à air pour tordre les fibres en vue de former un filé pouvant être utilisé pour la production de tissus à propriétés antistatiques permanentes, le ruban étant filé à des vitesses dépassant 70 mètres par minute.

8. Procédé selon la revendication 7, dans lequel le ruban est filé à des vitesses allant de 150 à 220 mètres par minute.

9. Procédé selon la revendication 7, dans lequel le fil du premier composant comprend entre environ 1 et 5% en poids du filé.

10. Procédé selon la revendication 7, dans lequel le fil du deuxième composant comprend entre environ 1 et 25% en poids du filé.

11. Procédé selon la revendication 7, dans lequel le fil du troisième composant comprend au moins environ 70% en poids du filé.

12. Procédé selon la revendication 1, dans lequel le fluide utilisé pour tordre les fibres est de l'air.

13. Procédé selon la revendication 6, dans lequel le fluide utilisé pour tordre les fibres est de l'air.